

IN THE CLAIMS:

1 1. (Currently Amended) A method for a storage operating system implemented in a
2 storage system to concurrently perform readahead operations for a plurality of different
3 read streams established in one or more files, directories, vdisks or luns stored in the
4 storage system, the method comprising:
5 allocating at least one readset data structure ("readset") for each of the one or
6 more files, directories, vdisks or luns in which the plurality of different read streams is
7 established, wherein the number of readsets allocated for each file, directory, vdisk or lun
8 depends on the size of that file, directory, vdisk or lun;
9 receiving a client read request at the storage system, the client read request
10 indicating client-requested data for the storage operating system to retrieve from a file,
11 directory, vdisk or lun stored in the storage system;
12 determining whether the received client read request matches any of the plurality
13 of readsets allocated for the file, directory, vdisk or lun containing the client-requested
14 data;
15 performing readahead operations in accordance with a set of readahead metadata
16 stored in an associated readset that is determined to match the received client read
17 request, wherein the readahead metadata describes the associated readset; and
18 if the received client read request does not match any of the readsets allocated for
19 the file, directory, vdisk or lun containing the client-requested data, then performing the
20 steps:
21 identifying the received client read request as being the first read
22 request in a new read stream;
23 generating a set of readahead metadata associated with the new
24 read stream;
25 selecting for reuse one of the readsets allocated for the file,
26 directory, vdisk or lun containing the client-requested data; and
27 storing the generated set of readahead metadata associated with the
28 new read stream in the readset selected for reuse.

1 2. (Previously Presented) The method of claim 1, further comprising:
2 generating a separate set of readahead metadata for each of the plurality of
3 different read streams; and
4 storing each generated set of readahead metadata in a different readset allocated
5 for the file, directory, vdisk or lun in which the read stream associated with the generated
6 set of readahead metadata is established.

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1 3. (Original) The method of claim 1, further comprising:
2 initializing each allocated readset to store a predetermined set of values.

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1 4. (Cancelled)

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1 5. (Previously Presented) The method of claim 2, wherein the number of readsets
2 allocated for a file, directory, vdisk or lun is dynamically increased as the size of that file,
3 directory, vdisk or lun is increased.

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1 6. (Original) The method of claim 1, wherein a first readset is determined to match the
2 received client read request if the first readset stores a set of readahead metadata
3 associated with a read stream that is extended by the client-requested data.

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1 7. (Original) The method of claim 1, wherein a second readset is determined to match
2 the received client read request when the client-requested data is located within a
3 predetermined fuzzy range associated with the second readset.

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1 8. (Original) The method of claim 7, wherein the fuzzy range is derived based on a
2 multiple of a number of client-requested data blocks specified in the received client read
3 request.

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1 9. (Original) The method of claim 7, wherein the fuzzy range extends in both a forward
2 direction and a backward direction in relation to a last data block retrieved in a read
3 stream associated with the second readset.

1 10. (Original) The method of claim 1, wherein a third readset is determined to match the
2 received client read request if the third readset is determined to be unused.

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1 11. (Original) The method of claim 10, wherein the third readset is determined to be
2 unused when a level value stored in the third readset equals a special indicator value.

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1 12. (Original) The method of claim 1, wherein readahead operations are not performed if
2 the storage operating system determines that the file, directory, vdisk or lun containing
3 the client-requested data is accessed using a random access style.

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1 13. (Original) The method of claim 12, wherein a DAFS cache hint included in the
2 received client read request indicates that the file, directory, vdisk or lun containing the
3 client-requested data is accessed using a random access style.

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1 14. (Original) The method of claim 1, wherein readahead operations are not performed
2 unless:

3 (i) a readset is determined to match the received client read request; and

4 (ii) the matching readset stores a set of readahead metadata associated
5 with a read stream that is extended by the client-requested data past a
6 predetermined data block or memory address.

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1 15. (Cancelled)

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1 16. (Currently Amended) The method of claim 1, wherein the readset selected for reuse
2 stores a level value that is less than or equal to level values stored in each of the other
3 readsets associated with the file, directory, vdisk or lun containing the client-requested
4 data.

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1 17. (Original) The method of claim 1, wherein the client read request received at the
2 storage system is a file-based client read request.

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1 18. (Original) The method of claim 1, wherein the client read request received at the
2 storage system is a block-based client read request.

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1 19-28 (Cancelled)

1 29. (Currently Amended) A storage system that employs a storage operating system to
2 concurrently perform readahead operations for a plurality of different read streams
3 established in one or more files, directories, vdisks or luns stored in the storage system,
4 the storage system comprising:

5 means for allocating at least one readset data structure ("readset") for each of the
6 one or more files, directories, vdisks or luns in which the plurality of different read
7 streams is established, wherein the number of readsets allocated for each file, directory,
8 vdisk or lun depends on the size of that file, directory, vdisk or lun;

9 means for receiving a client read request at the storage system, the client read
10 request indicating client-requested data for the storage operating system to retrieve from a
11 file, directory, vdisk or lun stored in the storage system;

12 means for determining whether the received client read request matches any of the
13 plurality of readsets" allocated for the file, directory, vdisk or lun containing the client-
14 requested data;

15 means for performing readahead operations in accordance with a set of readahead
16 metadata stored in an associated readset that is determined to match the received client
17 read request, wherein the readahead metadata describes the associated readset; and

18 if the received client read request does not match any of the readsets allocated for
19 the file, directory, vdisk or lun containing the client-requested data, then means for
20 performing:

21 means for identifying the received client read request as being the
22 first read request in a new read stream;

23 means for generating a set of readahead metadata associated with
24 the new read stream;

25 means for selecting for reuse one of the readsets allocated for the
26 file, directory, vdisk or lun containing the client-requested data; and

27 means for storing the generated set of readahead metadata
28 associated with the new read stream in the readset selected for reuse.

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1 30. (Currently Amended) A computer-readable media comprising instructions for
2 execution in a processor for the practice of a method for a storage operating system
3 implemented in a storage system to concurrently perform readahead operations for a
4 plurality of different read streams established in one or more files, directories, vdisks or
5 luns stored in the storage system, the method comprising:

6 allocating at least one readset data structure ("readset") for each of the one or
7 more files, directories, vdisks or luns in which the plurality of different read streams is
8 established, wherein the number of readsets allocated for each file, directory, vdisk or lun
9 depends on the size of that file, directory, vdisk or lun;

10 receiving a client read request at the storage system, the client read request
11 indicating client-requested data for the storage operating system to retrieve from a file,
12 directory, vdisk or lun stored in the storage system;

13 determining whether the received client read request matches any of the plurality
14 of readsets allocated for the file, directory, vdisk or lun containing the client-requested
15 data;

16 performing readahead operations in accordance with a set of readahead metadata
17 stored in an associated readset that is determined to match the received client read
18 request, wherein the readahead metadata describes the associated readset; and

19 if the received client read request does not match any of the readsets allocated for
20 the file, directory, vdisk or lun containing the client-requested data, then performing the
21 steps:

22 identifying the received client read request as being the first read
23 request in a new read stream;

24 generating a set of readahead metadata associated with the new
25 read stream;

26 selecting for reuse one of the readsets allocated for the file,
27 directory, vdisk or lun containing the client-requested data; and

28 storing the generated set of readahead metadata associated with the
29 new read stream in the readset selected for reuse.

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1 31. (Currently Amended) A method for a storage operating system implemented in a
2 storage system to concurrently perform readahead operations for a plurality of different
3 read streams established in one or more files stored in the storage system, comprising:
4 allocating at least one read set data structure ("readset") for each of the one or
5 more files, directories, vdisks or luns in which the plurality of different read streams is
6 established wherein the number of readsets allocated for each file depends on the size of
7 that file;
8 generating a separate set of readahead metadata for each of the plurality of
9 different read streams; and
10 storing each generated set of readahead metadata in a different readset allocated
11 for the file in which the read stream associated with the generated set of readahead
12 metadata is established;
13 receiving a client read request at the storage system, the client read request
14 indicating client-requested data for the storage operating system to retrieve from a file,
15 stored in the storage system;
16 determining whether the received client read request matches any of a plurality of
17 readsets allocated for the file containing the client-requested data; and
18 performing readahead operations in accordance with a set of readahead metadata
19 stored in a readset that is determined to match the received client read request; and
20 if the received client read request does not match any of the readsets allocated for
21 the file, directory, vdisk or lun containing the client-requested data, then performing the
22 steps:
23 identifying the received client read request as being the first read
24 request in a new read stream;
25 generating a set of readahead metadata associated with the new
26 read stream;
27 selecting for reuse one of the readsets allocated for the file,
28 directory, vdisk or lun containing the client-requested data; and

29 storing the generated set of readahead metadata associated with the
30 new read stream in the readset selected for reuse.

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1 32. (Previously Presented) The method of claim 31, wherein the file is broad term
2 describing either a file, directory, vdisk or lun.

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1 33. (Previously Presented) The method of claim 31, further comprising:
2 initializing each allocated readset to store a predetermined set of values.

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1 34. (Previously Presented) The method of claim 31, wherein the number of readsets
2 allocated for a file is dynamically increased as the size of that file is increased.

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1 35. (Previously Presented) The method of claim 31, wherein a first readset is determined
2 to match the received client read request if the first readset stores a set of readahead
3 metadata associated with a read stream that is extended by the client-requested data.

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1 36. (Previously Presented) The method of claim 31, wherein a second readset is
2 determined to match the received client read request when the client-requested data is
3 located within a predetermined fuzzy range associated with the second readset.

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1 37. (Previously Presented) The method of claim 36, wherein the fuzzy range is derived
2 based on a multiple of a number of client-requested data blocks specified in the received
3 client read request.

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1 38. (Previously Presented) The method of claim 36, wherein the fuzzy range extends in
2 both a forward direction and a backward direction in relation to a last data block retrieved
3 in a read stream associated with the second readset.

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1 39. (Previously Presented) The method of claim 31, wherein a third readset is determined
2 to match the received client read request if the third readset is determined to be unused.

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1 40. (Previously Presented) The method of claim 39, wherein the third readset is
2 determined to be unused when a level value stored in the third readset equals a special
3 indicator value.

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1 41. (Previously Presented) The method of claim 31, wherein readahead operations are not
2 performed if the storage operating system determines that the file, directory, vdisk or lun
3 containing the client-requested data is accessed using a random access style.

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1 42. (Previously Presented) The method of claim 41, wherein a DAFS cache hint included
2 in the received client read request indicates that the file, directory, vdisk or lun containing
3 the client-requested data is accessed using a random access style.

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1 43. (Previously Presented) The method of claim 31, wherein readahead operations are not
2 performed unless:

- 3 (i) a readset is determined to match the received client read request; and
4 (ii) the matching readset stores a set of readahead metadata associated
5 with a read stream that is extended by the client-requested data past a
6 predetermined data block or memory address.

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1 44. (Cancelled)

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1 45. (Currently Amended) The method of claim 31, wherein the readset selected for reuse
2 stores a level value that is less than or equal to level values stored in each of the other
3 readsets associated with the file, directory, vdisk or lun containing the client-requested
4 data.

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1 46. (Previously Presented) The method of claim 31, wherein the client read request
2 received at the storage system is a file-based client read request.

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1 47. (Previously Presented) The method of claim 31, wherein the client read request
2 received at the storage system is a block-based client read request.